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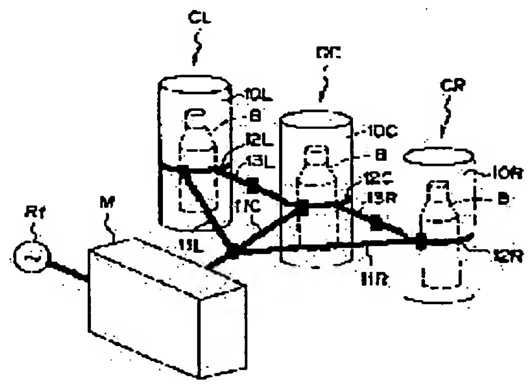
(54) APPARATUS AND METHOD FOR MANUFACTURE OF CARBON FILM COATED PLASTIC CONTAINER

(57)Abstract:
PROBLEM TO BE SOLVED: To reduce coating treatment time by connecting a plurality of external electrodes to a high frequency power source and connecting the plurality of external electrodes with one another via conductive lines.
SOLUTION: Three chambers C (CR, CC, CL) are arranged in parallel, and a high frequency electrode Rf is connected via a matching box M to external electrodes 10 (10R, 10C, 10L) constituting each chamber by conductive lines 11R, 11C, 11L. A plastic container B is received in each chamber C, and after material gas is supplied into each container B with the inside of each chamber C set at a vacuum, power is applied from the high frequency power source Rf to each external electrode 10, thereby generating plasma between the external electrode and an internal electrode in each chamber C to form a rigid carbon film on an internal wall face of the container B. At this time, the external electrodes 10R, 10C, 10L are short-circuited by conductive lines 13R, 13L, allowing power to be distributed to the respective electrodes 10 approximately uniformly.



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CLAIMS

[Claim(s)]
[Claim 1] While inserting an internal electrode into the container which held the container in the vacuum chamber formed in the external electrode, and was held in the vacuum chamber of this external electrode, making a vacuum chamber into a vacuum and supplying the material gas of a carbon source in a container By supplying power to an external electrode from an RF generator, and generating the plasma between an external electrode and an internal electrode In the manufacturing installation of the carbon film coating plastic envelope which forms the hard carbon film in the internal surface of a container, while two or more external electrodes are connected to said RF generator The manufacturing installation of the carbon film coating plastic envelope characterized by two or more of these external electrodes of each other being connected by lead wire.
[Claim 2] A vacuum chamber is formed by being attached, where said external electrode was divided into two or more parts and two or more of these divided parts of each other are insulated by the insulating member. The manufacturing installation of the carbon film coating plastic envelope according to claim 1 to which the divided parts which correspond mutually [two or more of these external electrodes] are connected by lead wire while the part into which two or more external electrodes were divided is connected to said RF generator, respectively.
[Claim 3] The manufacturing installation of the carbon film coating plastic envelope according to claim 1 or 2 to which the adjacent external electrode of each other is connected by lead wire while said two or more external electrodes are arranged in the shape of radii and each external electrode is connected to the RF generator by the lead wire prolonged in the shape of a straight line from the core of radii.
[Claim 4] The manufacturing installation of the carbon film coating plastic envelope according to claim 1 or 2 to which the adjacent external electrode of each other is connected by lead wire while said two or more external electrodes are arranged in the shape of a circle and each external electrode is connected to the RF generator by the lead wire of the shape of a straight line prolonged from the core of a circle.
[Claim 5] While inserting an internal electrode into the container which held the container in the vacuum chamber formed in the external electrode, and was held in the vacuum chamber of this external electrode, making a vacuum chamber into a vacuum and supplying the material gas of a carbon source in a container By supplying power to an external electrode from an RF generator, and generating the plasma between an external electrode and an internal electrode In the manufacturing installation of the carbon film coating plastic envelope which forms the hard carbon film in the internal surface of a container It has the reserve tank connected to said vacuum chamber through a bulb, and two or more vacuum pumps connected to a vacuum chamber through a bulb, respectively. The manufacturing installation of the carbon film coating plastic envelope characterized by performing exhaust air of a vacuum chamber gradually by the reserve tank and two or more vacuum pumps by carrying out sequential closing motion of each bulb.
[Claim 6] The manufacturing installation of the carbon film coating plastic envelope according to claim 5 which at least one of said two or more vacuum pumps consists of with the mechanical booster pump and the rotary pump.
[Claim 7] The manufacturing installation of the carbon film coating plastic envelope according to claim 5 whose at least one of said two or more vacuum pumps is cryopump.
[Claim 8] The manufacturing installation of a carbon film coating plastic envelope [equipped with the reserve tank for shared use by the reserve tank and two or more vacuum pumps with which said two or more external electrodes are classified into grades by two or more sets, and were installed for each class, and each class] according to claim 5.
[Claim 9] While inserting an internal electrode into the container which held the container in the vacuum chamber formed in the external electrode, and was held in the vacuum chamber of this external electrode, making a vacuum chamber into a vacuum and supplying the material gas of a carbon source in a container By supplying power to an external electrode from an RF generator, and generating the plasma between an external

electrode and an internal electrode In the manufacture approach of the carbon film coating plastic envelope which forms the hard carbon film in the internal surface of a container, while connecting two or more external electrodes to said RF generator The manufacture approach of the carbon film coating plastic envelope characterized by connecting two or more of these external electrodes of each other with lead wire.

[Claim 10] The manufacture approach of the carbon film coating plastic envelope according to claim 9 which connects the adjacent external electrode of each other with lead wire while arranging said two or more external electrodes in the shape of a circle and connecting each external electrode to an RF generator with the lead wire of the shape of a straight line prolonged from the core of a circle.

[Claim 11] While inserting an internal electrode into the container which held the container in the vacuum chamber formed in the external electrode, and was held in the vacuum chamber of this external electrode, making a vacuum chamber into a vacuum and supplying the material gas of a carbon source in a container By supplying power to an external electrode from an RF generator, and generating the plasma between an external electrode and an internal electrode In the manufacture approach of the carbon film coating plastic envelope which forms the hard carbon film in the internal surface of a container, while connecting a reserve tank to said vacuum chamber through a bulb The manufacture approach of the carbon film coating plastic envelope characterized by connecting two or more vacuum pumps through a bulb, respectively, and exhausting a vacuum chamber gradually with a reserve tank and two or more vacuum pumps by carrying out sequential closing motion of each bulb.

[Claim 12] Connect a reserve tank to said vacuum chamber through the 1st bulb, connect to it the vacuum pump which has a rotary pump through the 2nd bulb, and cryopump is connected to it through the 3rd bulb. After opening the 1st bulb and exhausting a vacuum chamber by the reserve tank, The manufacture approach of a carbon film coating plastic envelope according to claim 11 of opening the 2nd bulb, exhausting a vacuum chamber with a vacuum pump, opening the 3rd bulb after that, exhausting a vacuum chamber with cryopump, and reducing the pressure in a vacuum chamber to a necessary pressure.

[Claim 13] The manufacture approach of the carbon film coating plastic envelope according to claim 11 which connects the reserve tank of class common use to the vacuum chamber of the external electrode of each class, and exhausts the vacuum chamber by suction gradually by this common reserve tank and the reserve tank connected for each class while connecting said two or more external electrodes to two or more sets and connecting a reserve tank and two or more vacuum pumps to the vacuum chamber of an external electrode for a grouping opium poppy and each class.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the manufacturing installation and the manufacture approach of manufacturing the returnable container made from plastics.
[0002]
[Problem(s) to be Solved by the Invention] Generally, the container made from plastics is widely used as a restoration container in the field with the various food fields, drugs fields, etc. from various properties, such as a point that shaping is an easy point, a lightweight point, and low cost.
[0003] However, since plastics has the property to make low-molecular gas, such as oxygen and a carbon dioxide, penetrate, and the property (property which absorbs a low-molecular organic compound during the presentation of plastics) to sorb a low-molecular organic compound as known well, the container fabricated by this plastics receives constraint with those various use gestalten for use compared with other containers fabricated with glass etc.
[0004] For example, since the carbonated drink with which it fills up since oxygen penetrates plastics and permeates the interior of a container oxidizes with time, and carbon dioxide gas penetrates plastics, and is emitted to the exterior of a container and the mind of a carbonated drink falls out in using this plastic envelope as a restoration container of carbonated drinks, such as Biel, the plastic envelope is not used as a restoration container of a carbonated drink.
[0005] Moreover, since the sorption of the aroma components (for example, limonene of orange juice etc.) which are the low-molecular organic compounds contained in a drink is carried out to plastics when using this plastic envelope as a restoration container of the drink which has aroma components, such as orange juice, the balance of a presentation of the aroma component of a drink collapses and the quality of that drink deteriorates, the plastic envelope is not used as a restoration container of the drink which has an aroma component.
[0006] Moreover, since there is a possibility of beginning to melt into the matter (especially liquid) with which it fills up with low molecular weight compounds, such as a plasticizer contained during the plastics presentation and an additive of a residual monomer and others, and spoiling the purity of the matter, the plastic envelope is not used as a restoration container of matter with which especially purity is required.
[0007] When it is left by the plastic envelope in an environment in the case of recovery unlike [although recent years especially come on the other hand, recycle-ization of a resource comes to be cried for and recovery of a used container has been a problem, when using a plastic envelope as a returnable container] glassware etc., the sorption of the various low-molecular [mold odor] organic compound will be carried out to plastics between them. And since after washing of a container remains in the presentation of plastics, the low-molecular organic compound by which the sorption was carried out to this plastics is insanitary, and when this plastic envelope is moreover re-filled up with contents, it has a possibility of beginning to melt gradually as heterogeneity and causing the debasement of contents into the contents with which it filled up. For this reason, in the former, the example which uses a plastic envelope as a returnable container was restricted.
[0008] However, since it has properties, such as the ease of shaping, lightweight nature, and low cost nature, as mentioned above, the plastic envelope is very convenient if this plastic envelope can be further used as a returnable container as restoration containers, such as a drink which has a carbonated drink and a flavor component, and a restoration container of the matter with which purity is demanded.
[0009] The applicant of the invention in this application is performing the proposal for using a plastic envelope as a returnable container in the patent application (JP,8-53117,A) performed previously paying attention to the convenience of such a plastic envelope.
[0010] Invention concerning the patent application of the point by the applicant of this invention in this application relates to the equipment which forms the DLC (Diamond Like Carbon) film in the internal surface of a plastic envelope, in order to raise the gas barrier nature of a plastic envelope and to intercept the sorption of

the low-molecular organic compound to a plastic envelope.
[0011] Here, the DLC film is hard ca[illegible] film called i carbon film or the hydro[illegible]tion amorphous carbon film (a-C:H), it is the amorphous carbon film [illegible]ch made SP3 association the subject, [illegible]d while it is very hard and excelling in insulation, it has the high refractive index.
[0012] The manufacturing installation of the carbon film coating plastic envelope concerning the patent application of this point manufactures a plastic envelope usable as a returnable container by forming the thin film of this DLC in the internal surface of a plastic envelope, and intercepting transparency of the gas from plastics, and the sorption of the low-molecular organic compound to plastics.
[0013] That is, as shown in drawing 12 , the manufacturing installation of this carbon film coating plastic envelope is equipped with the electric insulating plate 2 made from a ceramic attached on the pedestal 1, the external electrode 3 attached on this electric insulating plate 2, and the internal electrode 4 inserted into chamber 3a formed in this external electrode 3.
[0014] After the external electrode 3 of this manufacturing installation constitutes a vacuum chamber for chamber 3a formed in that inside to perform plasma discharge, plastic envelope B is inserted into body section 3A and the inside of a chamber is sealed by lid 3B, by the vacuum pump which is not illustrated from an exhaust pipe 5, air is discharged and the inside of chamber 3a is made into a vacuum.
[0015] And after the material gas supplied from the material gas supply pipe 6 in chamber 3a of the vacuum of this external electrode 3 blows off from blow-off hole 4A of an internal electrode 4 and is spread in homogeneity, the DLC film is formed in the internal surface of plastic envelope B when the plasma is generated by the external electrode 3 from RF generator Rf through a matching box (adjustment machine) M between the internal electrodes 4 which power was switched on and grounded.
[0016] The manufacturing installation of the above-mentioned carbon film coating plastic envelope Chamber 3a of the external electrode 3 is mostly formed in an analog in accordance with the appearance of plastic envelope B, and the appearance of an internal electrode 4 is mostly formed in the analog along with the internal surface of plastic envelope B, and mutual spacing is mostly maintained at homogeneity. Further When material gas blows off inside plastic envelope B, it is characterized by the ability to form the DLC film only in the internal surface of plastic envelope B.
[0017] And further, since chamber 3a in the external electrode 3 constitutes a vacuum chamber, the manufacturing installation of this carbon film coating plastic envelope can shorten sharply the purge timing for making this chamber 3a into a vacuum, and has the description that the mass production of the returnable container made from plastics is attained by this.
[0018] In addition, in order for plastic envelopes to collide or rub in the selling root in the production process in works when this plastic envelope is used as a returnable container if the DLC film is formed in the external surface of a plastic envelope, formation of the DLC film is limited only to the internal surface of plastic envelope B, and is performed, because there is a possibility of the thin and hard DLC film itself being damaged and spoiling the commodity value of plastic envelope B.
[0019] Here, in order to use a DLC film coating plastic envelope as a returnable container in a commercial scene, while the coating condition of the DLC film is the same about each DLC film coating plastic envelope which this DLC film coating plastic envelope was mass-produced, and it is required for a commercial scene to appear on the market in large quantities, and was mass-produced further, it is required that a manufacturing cost should be cheap.
[0020] In order that the artificer of this invention might mass-produce a DLC film coating plastic envelope based on such a request, as shown in drawing 13 , two or more chambers (drawing three chambers CR, CC, and CL) were put in order, RF generator Rf of a piece was connected to each manufacturing installation through the matching box M, power was supplied to each chamber from this RF generator Rf, and the experiment which manufactures two or more DLC film coating plastic envelopes to coincidence was conducted.
[0021] However, when the number of chambers tends to be increased like drawing 13 and it is going to mass-produce a DLC film coating plastic envelope Although it is required to keep coating conditions completely the same about each chamber in order to change into the same condition the DLC film of each other formed in a plastic envelope in each chambers CR, CC, and CL If it actually experiments, the switched-on power would not be supplied to each chamber at homogeneity, but, for this reason, dispersion will have arisen on the DLC film formed in the plastic envelope.
[0022] When the number of chambers was increased and a DLC film coating plastic envelope was mass-produced from the result of this experiment, it was very difficult technically to keep coating conditions completely the same about each chamber, and it became clear that it was the biggest technical problem in fertilization of a DLC film coating plastic envelope how the coating conditions of the DLC film in each chamber are kept the same.

[0023] Moreover, in order to lower the manufacturing cost of a DLC film coating plastic envelope, and to gather manufacture effectiveness, it becomes a technical problem to shorten the coating processing time in 1 time of a stroke.
[0024] The invention in this application is made in order to solve the technical problem in fertilization of the above hard carbon film coating plastic envelopes.
[0025] That is, the invention in this application sets it as the 1st purpose to offer the manufacturing installation and the manufacture approach of a carbon film coating plastic envelope that the coating condition of the hard carbon film can mass-produce the same coating plastic envelope.
[0026] Furthermore, the invention in this application sets it as the 2nd purpose to offer the manufacturing installation and the manufacture approach of a carbon film coating plastic envelope which can shorten the coating processing time in 1 time of a stroke, and can gather manufacture effectiveness.
[0027]
[Means for Solving the Problem] The manufacturing installation of the carbon film coating plastic envelope by the 1st invention In order to attain the 1st purpose of the above, while inserting an internal electrode into the container which held the container in the vacuum chamber formed in the external electrode, and was held in the vacuum chamber of this external electrode, making a vacuum chamber into a vacuum and supplying the material gas of a carbon source in a container By supplying power to an external electrode from an RF generator, and generating the plasma between an external electrode and an internal electrode In the manufacturing installation of the carbon film coating plastic envelope which forms the hard carbon film in the internal surface of a container, while two or more external electrodes are connected to said RF generator, it is characterized by two or more of these external electrodes of each other being connected by lead wire.
[0028] Moreover, the manufacture approach of the carbon film coating plastic envelope by the 9th invention In order to attain said 1st purpose, a container is held in the vacuum chamber formed in the external electrode. While inserting an internal electrode into the container held in the vacuum chamber of this external electrode and making a vacuum chamber into a vacuum, after supplying the material gas of a carbon source in a container, By supplying power to an external electrode from an RF generator, and generating the plasma between an external electrode and an internal electrode In the manufacture approach of the carbon film coating plastic envelope which forms the hard carbon film in the internal surface of a container, while connecting two or more external electrodes to said RF generator, it is characterized by connecting two or more of these external electrodes of each other with lead wire.
[0029] The manufacturing installation of a carbon film coating plastic envelope by the 1st above-mentioned invention, and the manufacture approach of the carbon film coating plastic envelope by the 9th invention After a plastic envelope is held in the vacuum chamber of each external electrode, respectively and this vacuum chamber is made into a vacuum, while material gas is supplied to the interior of each plastic envelope By supplying power to each external electrode from an RF generator, the plasma is generated between internal electrodes in each vacuum chamber, and the hard carbon film is formed in it at the internal surface of a plastic envelope.
[0030] At this time, when two or more external electrodes have short-circuited with lead wire, respectively, the power switched on from an RF generator is distributed to each external electrode almost equally, and when other coating conditions, such as the amount of supply of the vacuum conditions in the vacuum chamber of each external electrode and material gas, are made the same by this, two or more hard carbon film coating plastic envelopes with the almost same coating condition are manufactured to coincidence.
[0031] Thus, according to the manufacturing installation of a carbon film coating plastic envelope by the 1st above-mentioned invention, and the manufacture approach of the carbon film coating plastic envelope by the 9th invention Only by only connecting two or more external electrodes to an RF generator, respectively Although dispersion arises in the thickness of the hard carbon film formed in a plastic envelope since the power from an RF generator is not equally distributed to each external electrode by the difference in the connection resistance in each connection of the lead wire which connects each external electrode and an RF generator, or a curve resistance value etc. By making it the circuitry which short-circuits two or more external electrodes of each other with lead wire, it becomes possible to distribute equally the power switched on from an RF generator to each external electrode, and to manufacture two or more hard carbon film coating plastic envelopes with the almost same coating condition to coincidence.
[0032] The manufacturing installation of the carbon film coating plastic envelope by the 2nd invention In addition, a vacuum chamber is formed by being attached, where said external electrode was divided into two or more parts and two or more of these divided parts of each other are insulated by the insulating member. the configuration of the 1st invention in order to attain said 1st purpose -- While the part into which two or more external electrodes were divided is connected to said RF generator, respectively, it is characterized by the

divided parts which correspond mutually [two or more of these external electrodes] being connected by lead wire.
[0033] The manufacturing installation of the carbon film coating plastic envelope by this 2nd invention When spacing between the external electrode corresponding to each part of the plastic envelope held into it in a vacuum chamber from constraint by the configuration of a plastic envelope of performing coating etc., and an internal electrode differs Since the thickness of the hard carbon film formed in each part of a plastic envelope in having switched on the power of the same magnitude as each part of an external electrode differs By dividing an external electrode, and the power corresponding to spacing with an internal electrode being separately adjusted by each part, respectively, and supplying it to it, it continues all over a plastic envelope and the uniform hard carbon film is formed. And in case two or more external electrodes divided into two or more of these parts are connected to an RF generator, when the divided parts have short-circuited with lead wire mutually [two or more of these external electrodes] While the power from an RF generator is equally distributed to the division part which corresponds mutually [each external electrode], covering the whole surface and forming the uniform hard carbon film, a coating condition makes it possible to manufacture two or more almost same hard carbon film coating plastic envelopes to coincidence.
[0034] in order that the manufacturing installation of the carbon film coating plastic envelope by the 3rd invention may attain said 1st purpose -- the configuration of the 1st invention or the 2nd invention -- in addition, said two or more external electrodes are arranged in the shape of radii, and while each external electrode is connected to the RF generator by the lead wire prolonged in the shape of a straight line from the core of radii, it is characterized by the adjacent external electrode of each other being connected by lead wire.
[0035] The manufacturing installation of the carbon film coating plastic envelope by this 3rd invention While two or more external electrodes which can be set to the 1st invention or invention of the 2nd have short-circuited mutually with lead wire Since it is performed by the lead wire with which it is arranged in the shape of radii, and connection with an RF generator is prolonged in the shape of a straight line from the core of radii Since each lead wire is prolonged in a straight line and curve resistance does not occur while being able to make equal mutually the die length of the lead wire from an RF generator to each external electrode It makes it possible for power to be more equally distributed to each external electrode from an RF generator by this, and to manufacture two or more hard carbon film coating plastic envelopes of the more nearly same coating condition to coincidence by it.
[0036] in order that the manufacturing installation of the carbon film coating plastic envelope by the 4th invention may attain said 1st purpose -- the configuration of the 1st invention or the 2nd invention -- in addition, said two or more external electrodes are arranged in the shape of a circle, and while each external electrode is connected to the RF generator by the lead wire of the shape of a straight line prolonged from the core of a circle, it is characterized by the adjacent external electrode of each other being connected by lead wire.
[0037] moreover, the configuration of the 9th invention in order that the manufacture approach of the carbon film coating plastic envelope by the 10th invention may attain said 1st purpose -- in addition, said two or more external electrodes are arranged in the shape of a circle, and while connecting each external electrode to an RF generator with the lead wire of the shape of a straight line prolonged from the core of a circle, it is characterized by connecting the adjacent external electrode of each other with lead wire.
[0038] The manufacturing installation of a carbon film coating plastic envelope by the 4th above-mentioned invention, and the manufacture approach of the carbon film coating plastic envelope by the 10th invention Since it is performed by the lead wire with which two or more external electrodes which can be set to the 1st invention or invention of the 2nd are arranged in the shape of a circle, and connection with an RF generator is prolonged in the shape of a straight line from the core of this circle While being able to make equal all the die length of the lead wire from an RF generator to each external electrode, each lead wire is not made to produce curve resistance. And when what the external electrode arranged in the shape of [this] a circle adjoins, respectively connects too hastily with lead wire, the condition of the short circuit in each external electrode becomes the same, and it becomes possible to mutual completely make the same the coating conditions in each external electrode by this, and makes it possible to mass-produce the hard carbon film coating plastic envelope of the more nearly same coating condition to coincidence.
[0039] The manufacturing installation of the carbon film coating plastic envelope by the 5th invention In order to attain said 2nd purpose, while inserting an internal electrode into the container which held the container in the vacuum chamber formed in the external electrode, and was held in the vacuum chamber of this external electrode, making a vacuum chamber into a vacuum and supplying the material gas of a carbon source in a container By supplying power to an external electrode from an RF generator, and generating the plasma between an external electrode and an internal electrode In the manufacturing installation of the carbon film coating plastic

envelope which forms the hard carbon film in the internal surface of a container It has the reserve tank connected to said vacuum chamber through a bulb, and two or more vacuum pumps connected to a vacuum chamber through a bulb, respectively. It is characterized by performing exhaust air of a vacuum chamber gradually by the reserve tank and two or more vacuum pumps by carrying out sequential closing motion of each bulb.

[0040] Moreover, the manufacture approach of the carbon film coating plastic envelope by the 11th invention In order to attain said 2nd purpose, while inserting an internal electrode into the container which held the container in the vacuum chamber formed in the external electrode, and was held in the vacuum chamber of this external electrode, making a vacuum chamber into a vacuum and supplying the material gas of a carbon source in a container By supplying power to an external electrode from an RF generator, and generating the plasma between an external electrode and an internal electrode In the manufacture approach of the carbon film coating plastic envelope which forms the hard carbon film in the internal surface of a container, while connecting a reserve tank to said vacuum chamber through a bulb It is characterized by connecting two or more vacuum pumps through a bulb, respectively, and exhausting a vacuum chamber gradually with a reserve tank and two or more vacuum pumps by carrying out sequential closing motion of each bulb.

[0041] The manufacturing installation of a carbon film coating plastic envelope by the 5th above-mentioned invention, and the manufacture approach of the carbon film coating plastic envelope by the 11th invention After a plastic envelope is held in the vacuum chamber of each external electrode, respectively and this vacuum chamber is made into a vacuum, while material gas is supplied to the interior of each plastic envelope By supplying power to each external electrode from an RF generator, the plasma is generated between internal electrodes in each vacuum chamber, and the hard carbon film is formed in it at the internal surface of a plastic envelope.

[0042] And if a plastic envelope is held in the vacuum chamber of an external electrode, the bulb of a reserve tank by which the interior was beforehand maintained by the predetermined degree of vacuum can open, by this reserve tank, the air in a vacuum chamber will be attracted and that pressure will be reduced at a stretch. Furthermore, a degree of vacuum required for plasma discharge is obtained by carrying out sequential actuation of two or more vacuum pumps with which capacity differs after this in the pressure field in which each is adapted.

[0043] According to the manufacturing installation of a carbon film coating plastic envelope by this 5th invention, and the manufacture approach of the carbon film coating plastic envelope by the 11th invention While the exhaust air in the vacuum chamber of an external electrode is performed at a stretch by the reserve tank beforehand maintained by the predetermined degree of vacuum Then, by carrying out sequential actuation of two or more vacuum pumps with which properties differ, and demonstrating each capacity in the pressure field suitable for the property of each vacuum pump to the maximum extent A high degree of vacuum can be obtained by short time amount, and the manufacture effectiveness of a hard carbon film coating plastic envelope can be gathered by this. Moreover, since it is the configuration that the load of each vacuum pump is mitigated, continuous running becomes possible.

[0044] In addition to the 5th configuration of invention, the manufacturing installation of the carbon film coating plastic envelope by the 6th invention is characterized by constituting at least one of said two or more vacuum pumps with the mechanical booster pump and the rotary pump, in order to attain said 2nd purpose.

[0045] If the pressure in a vacuum chamber declines to some extent with a rotary pump, the manufacturing installation of the carbon film coating plastic envelope by this 6th invention will exhaust to a necessary pressure for a short time, when a mechanical booster pump operates auxiliary in the low voltage force field to which the actuation effectiveness of this rotary pump falls.

[0046] In addition to the 5th configuration of invention, the manufacturing installation of the carbon film coating plastic envelope by the 7th invention is characterized by at least one of said two or more vacuum pumps being cryopump, in order to attain said 2nd purpose.

[0047] The manufacturing installation of the carbon film coating plastic envelope by this 7th invention can perform the exhaust air in a vacuum chamber in a low voltage force field at high speed by carrying out coagulation adsorption of all the gas molecules in a vacuum chamber with cryopump.

[0048] The manufacturing installation of the carbon film coating plastic envelope by the 8th invention is characterized by having the reserve tank for shared use by the reserve tank and two or more vacuum pumps with which said two or more external electrodes are classified into grades by two or more sets, and were installed for each class, and each class in addition to the 5th configuration of invention, in order to attain said 2nd purpose.

[0049] Moreover, the manufacture approach of the carbon film coating plastic envelope by the 13th invention In order to attain said 2nd purpose, while in addition to the 11th configuration of invention connecting said two or

more external electrodes to two or more sets and connecting a reserve tank and two or more vacuum pumps to the vacuum chamber of an external electrode for a grouping opium poppy and each class It is characterized by connecting the reserve tank of class common use to the vacuum chamber of the external electrode of each class, and exhausting the vacuum chamber by suction gradually by this common reserve tank and the reserve tank connected for each class.

[0050] The manufacturing installation of a carbon film coating plastic envelope by the 8th above-mentioned invention, and the manufacture approach of the carbon film coating plastic envelope by the 13th invention In order to mass-produce a carbon film coating plastic envelope, in case it increases the number of external electrodes and the production number in 1 time of a stroke is increased, in order to prevent that the purge timing of a vacuum chamber becomes long by the increment in the number of an external electrode One or more reserve tanks which the external electrode of each class shares with the reserve tank prepared for each class of an external electrode are prepared. The vacuum chamber by suction is gradually exhausted by this common reserve tank and the reserve tank prepared for each class of an external electrode. And when mass-producing a hard carbon film coating plastic envelope by using a mass reserve tank as a common reserve tank, for example, purge timing can shorten further.

[0051] The manufacture approach of the carbon film coating plastic envelope by the 12th invention In order to attain said 2nd purpose, connect a reserve tank to said vacuum chamber through the 1st bulb, connect to it the vacuum pump which has a rotary pump through the 2nd bulb, and cryopump is connected to it through the 3rd bulb. After opening the 1st bulb and exhausting a vacuum chamber by the reserve tank, It is characterized by opening the 2nd bulb, exhausting a vacuum chamber with a vacuum pump, opening the 3rd bulb after that, exhausting a vacuum chamber with cryopump, and reducing the pressure in a vacuum chamber to a necessary pressure.

[0052] The manufacture approach of the carbon film coating plastic envelope by the 12th above-mentioned invention performs the exhaust air in a vacuum chamber gradually, when sequential closing motion of the 1st thru/or the 3rd bulb is carried out for the vacuum pump and cryopump which have the reserve tank connected to the vacuum chamber of an external electrode, and a rotary pump by control of a microcomputer etc., respectively. That is, after reducing the pressure of a vacuum chamber at a stretch by the reserve tank which the 1st bulb was opened and was beforehand maintained by the predetermined degree of vacuum, a necessary high degree of vacuum is obtained by the 2nd bulb being opened and reducing the pressure of a vacuum chamber further with a vacuum pump, opening the 3rd bulb after that and carrying out coagulation adsorption of the gas molecule of a vacuum chamber with cryopump.

[0053]

[Embodiment of the Invention] Hereafter, it explains, referring to a drawing about the gestalt of the implementation of this invention considered to be the most suitable.

[0054] Drawing 1 shows an example of the operation gestalt of the manufacturing installation of the carbon film coating plastic envelope by this invention.

[0055] In this drawing 1 , two or more chambers (the example of illustration three chambers CR, CC, and CL) are put in order by juxtaposition like the case of drawing 13 , and RF generator Rf is connected to the external electrodes 10R, 10C, and 10L which constitute each of this chamber by lead wire 11R, 11C, and 11L through the matching box M, respectively.

[0056] Connection with each external electrodes 10R, 10C, and 10L of these lead wire 11R, 11C, and 11L is made by connecting the point of the external electrodes 10R, 10C, and 10L with the copper plates 12R, 12C, and 12L wound around the peripheral face of each external electrodes 10R, 10C, and 10L, respectively.

[0057] And when each copper plate 12R and 12C short-circuits by lead-wire 13R, it connects mutually, and the external electrodes 10R and 10C of each other are further connected, when each copper plate 12C and 12L short-circuits [the external electrodes 10C and 10L] by lead-wire 13L.

[0058] After plastic envelope B is held in each chambers CR and CC and CL, respectively and the inside of these chambers CR and CC and CL is made into a vacuum by exhaust air of air, as for the equipment of this drawing 1 , material gas is supplied to the interior of each plastic envelope B. And after this, power is supplied to each external electrodes 10R, 10C, and 10L through a matching box M from RF generator Rf, and the DLC film is formed in the internal surface of plastic envelope B like the case of the equipment of drawing 12 of the plasma generated between internal electrodes in each chambers CR and CC and CL.

[0059] At this time, when the external electrodes 10R and 10C and the external electrodes 10C and 10L have short-circuited with lead wire 13R and 13L, respectively, the power switched on from RF generator Rf is distributed to each external electrodes 10R, 10C, and 10L almost equally. A DLC film coating plastic envelope with the almost same coating condition is manufactured by coincidence by making the same other coating conditions, such as the amount of supply of the vacuum conditions in each chambers CR, CC, and CL, and

material gas, by this.
[0060] That thus, each external electrodes 10R, 10C, and 10L have short-circuited with lead wire 13R and 13L As mentioned above, in not short-circuiting between each external electrodes 10R and 10C and 10L It is for dispersion to arise in the thickness of the DLC film which the power from RF generator Rf is not equally distributed to each external electrodes 10R, 10C, and 10L, but becomes the inclination for the power supplied to central external electrode 10C to become large, and is formed in plastic envelope B.
[0061] It became clear that dispersion in the injection power between such each chambers CR and CC and CL was what is depended on the difference in the resistance of the lead wire 11R, 11C, and 11L from RF generator Rf to each external electrodes 10R, 10C, and 10L as a result of consideration.
[0062] Then, although experimented by making equal the die length of each lead wire 11R, 11C, and 11L By the difference in the connection resistance in a connection with each copper plates 12R, 12C, and 12L of each lead wire 11R, 11C, and 11L etc., the difference in the curve resistance value by lead wire 11R, 11C, and 11L curving, etc. It is difficult to completely make the same the connection condition of each lead wire 11R, 11C, and 11L, respectively, and power was not able to be equally supplied to each chambers CR, CC, and CL.
[0063] In order to have distributed equally the power switched on from RF generator Rf from the result of such an experiment to each chambers CR, CC, and CL by trial-and-error, the coating condition made it possible to manufacture the almost same DLC film coating plastic envelope to coincidence by solving that it is the best approach to short-circuit the chambers CR, CC, and CL of each other with lead wire 13R and 13L, and making it into circuitry as shown in drawing 1 .
[0064] In addition, although the example in case the number of chambers is three is shown in drawing 1 , even if it is a case with still more chambers, by short-circuiting each chamber of each other with lead wire with the small resistance of copper wire etc., injection power can be distributed equally and a coating condition can manufacture many almost same DLC film coating plastic envelopes to coincidence.
[0065] Drawing 2 shows other examples of the embodiment of this invention.
[0066] each chamber CR' in this example, CC', and CL -- ' -- drawing shows -- as -- each external electrode 10R', 10C', and 10L -- ' -- It is divided into two parts of upper part 10Ra, 10calcium, 10La, lower partial 10Rb, 10Cb, and 10Lb by the flat surface which intersects perpendicularly with the axis, respectively. Between each of this upper part 10Ra, 10calcium, 10La, lower partial 10Rb, 10Cb, and 10Lb(s) is insulated by electric insulating plate 10Rc, 10Cc, and 10Lc, respectively.
[0067] and -- each -- the exterior -- an electrode -- ten -- R -- ' -- ten -- C -- ' -- ten -- L -- ' -- the upper part -- ten -- Ra -- ten -- calcium -- ten -- La -- **** -- RF generator Rf and the matching box M are connected by lead-wire 11Ra, 11calcium, and 11La through circuit-changing-switch S, respectively. moreover, to lower partial 10Rb, 10Cb, and 10Lb RF generator Rf and the matching box M are connected by lead-wire 11Rb, 11Cb, and 11Lb through circuit-changing-switch S, respectively, and power is separately supplied to the upper part and the lower part of each chamber by switch of circuit-changing-switch S.
[0068] thus, each external electrode 10R', 10C', and 10L -- ' -- upper part 10Ra, 10calcium, and 10 -- that La, lower partial 10Rb, 10Cb, and 10Lb are divided up and down From constraint by the configuration of plastic envelope B which performs coating etc., when spacing between the external electrode in the part between [the regio oralis of plastic envelope B to] shoulders and an internal electrode becomes narrower than spacing between the two electrodes in the part of the drum section of plastic envelope B Since the thickness of the DLC film formed in the parts of the regio oralis of plastic envelope B and a shoulder and the part of a drum section in having switched on the power of the up and down same magnitude of an external electrode differs a plastic envelope -- B -- a front face -- continuing -- being uniform -- DLC -- the film -- forming -- a sake -- each -- the exterior -- an electrode -- ten -- R -- ' -- ten -- C -- ' -- ten -- L -- ' -- the upper part -- ten -- Ra -- ten -- calcium -- ten -- La -- the lower part -- a part -- ten -- Rb -- ten -- Cb -- ten -- Lb -- power -- respectively -- separate -- adjusting -- it can supply -- making -- a sake -- it is .
[0069] Upper part 10calcium of upper part 10Ra of each external electrode 10R' and external electrode 10C' by the same mode as the case of the equipment of drawing 1 and by lead-wire 13Ra Moreover, upper part 10La of upper part 10calcium of external electrode 10C' and external electrode 10L' has connected too hastily by lead-wire 13La, respectively. Furthermore, lower partial 10Cb of lower partial 10Rb of each external electrode 10R' and external electrode 10C' connects too hastily by lead-wire 13Rb, and lower partial 10Lb of lower partial 10Cb of external electrode 10C' and external electrode 10L' has connected too hastily by lead-wire 13Lb, respectively.

[0070] this -- an RF generator -- Rf -- from -- a matching box -- M -- and -- a circuit changing switch -- S -- minding -- each -- the exterior -- an electrode -- ten -- R -- ' -- ten -- C -- ' -- ten -- L -- ' -- the upper part -- ten -- Ra -- ten -- calcium -- ten -- La -- power -- supplying -- having had -- the time -- Power is distributed to the upper part of each external power almost equally, and the DLC film of the

respectively almost same coating condition can be formed in the regio oralis and shoulder of plastic envelope B which were held in each external electrode. furthermore -- a circuit changing switch -- S -- a change -- each -- the exterior -- an electrode -- ten -- R -- ' -- ten -- C -- ' -- ten -- L -- ' -- the lower part -- a part -- ten -- Rb -- ten -- Cb -- ten -- Lb -- power -- supplying -- having had -- the time -- Power is distributed to the lower part of each external power almost equally, and can form the DLC film of the respectively almost same coating condition in the drum section of plastic envelope B held in each external electrode.
[0071] and -- each -- the exterior -- an electrode -- ten -- R -- ' -- ten -- C -- ' -- ten -- L -- ' -- the upper part -- ten -- Ra -- ten -- calcium -- ten -- by adjusting the magnitude or the making time of power supplied to La, lower partial 10Rb, 10Cb, and 10Lb, it can continue all over the about each plastic envelope B, and the DLC film can be formed equally.
[0072] In drawing 1 and the equipment of 2, when between each chambers CR and CC and CL (CR', CC', CL') has connected too hastily with lead wire 13R and 13L (13Ra, 13Rb and 13La(s), 13Lb), here Although the coating conditions of the DLC film in each chambers CR, CC, and CL (CR', CC', CL') can fully be brought close to extent it can consider that is the same When each chambers CR, CC, and CL (CR', CC', CL') have been arranged in the shape of a straight line like illustration The central chamber CC (CC') will be arranged in near to a power supply section (RF generator Rf and a matching box M) rather than the chambers CR and CL (CR', CL') arranged at the both sides. Even if it connects a matching box M and each chambers CR, CC, and CL (CR', CC', CL') with the lead wire of the same die length It is in the inclination for the power distributed to the chamber CC of the center where distance with a power supply section is short (CC') to become large, and, for this reason, it is difficult to make the same completely the coating conditions in each chambers CR, CC, and CL (CR', CC', CL').
[0073] Then, as for the equipment shown in drawing 3 , Chambers CR, CC, and CL (CR', CC', CL') are arranged in the shape of radii around a power supply section (RF generator Rf and a matching box M). Each chamber is located in the equal distance to the power supply section {therefore, also in lead-wire 11R (11Ra, 11Rb) which connects each chamber with RF generator Rf, 11C' (11calcium', 11Cb'), and 11L (11La, 11Lb), the die length is equal}. By this, the coating conditions in each chamber can be close brought further mutually rather than the case of drawing 1 and the equipment of 2.
[0074] In order that the equipment shown in drawing 4 thru/or 7 may improve the equipment of drawing 3 further, the chamber [two or more (the example of illustration 25 pieces)] C which performs coating to plastic envelope B is arranged in accordance with the periphery in the equiangular distance location.
[0075] Each chamber C is attached in the condition of having hung into the vacuum duct D fabricated by the doughnut mold of the vacuum devices which body section 10A of the external electrode 10 mentions later, respectively, and in this drawing 4 thru/or 7, as shown especially in drawing 7 , it is arranged so that a circle may be formed.
[0076] Under the external electrode 10 attached in this vacuum duct D, the rise-and-fall table T which goes up and down to the vertical sense with the lifting device which is not illustrated is arranged, and it is arranged in the location where covering device 10B of the external electrode 10 counters on this rise-and-fall table T at each body section 10A of the external electrode 10.
[0077] It is arranged so that it may be located in the core of the chamber C arranged in accordance with a periphery as mentioned above, and as for RF generator Rf and the matching box M, this RF generator Rf is connected to body section 10A of the external electrode 10 of each chamber C through the matching box M by the lead wire 11 prolonged in the method of outside from the center position of each chamber C at a radial, respectively.
[0078] And body section 10A of the adjoining external electrode 10 has short-circuited each chamber C of each other with lead wire 13.
[0079] As the center section of the vacuum duct D shown in drawing 4 thru/or 6, it connects with the vacuum duct D through four bulbs V1 which the reserve tank RT has been arranged and have been arranged around this reserve tank RT at the equiangular distance. And vacuum-pump PA is connected to this reserve tank RT, and the exhaust air in a reserve tank RT is performed by actuation of this vacuum-pump PA.
[0080] The exhaust air in each chamber C is gradually performed into the vacuum duct D through the vacuum duct D by carrying out sequential actuation of each pump so that Cryopump PC may be connected through the bulb V3, respectively and a vacuum pump PB may mention later through a bulb V2 further.
[0081] The configuration and actuation of these vacuum devices are explained in full detail later.
[0082] This drawing 4 thru/or the equipment of 7 are laid after plastic envelope B which performs coating to each covering device 10B on the rise-and-fall table T in a downward location has stood straight, respectively, as shown in drawing 4 , and when the rise-and-fall table T goes up after this, plastic envelope B is held in body section 10A corresponding to each covering device 10B of the external electrode 10.
[0083] And after sequential closing motion of a bulb V1 thru/or 3 is carried out and the inside of each chamber

C is made a vacuum by actuation of a reserve tank RT, a vacuum pump PB, and Cryopump PC through the vacuum duct D, the interior of plastic envelope B carbon source gas was held in chamber C from the material gas feeder RM through the massflow controller MC is supplied.
[0084] The DLC film is formed in the internal surface of plastic envelope B by supplying power to the external electrode 10 of each chamber C from RF generator Rf through a matching box M with this, and generating the plasma by this between each external electrode 10 and the internal electrode arranged in the external electrode 10 (it is the same as that of the case of the equipment of drawing 12 as the formation fault of the DLC film by this plasma).
[0085] While each chamber C is arranged to RF generator Rf at the equal distance and each lead wire 11 has the same die length at this time As opposed to having connected with the central chamber CC and the chambers CR and CL (CR' and CL') of both sides having connected the central chamber CC (CC') with two chambers CR and CL (CR' and CL') of both sides too hastily with drawing 1 thru/or the equipment of 3 By having connected with the chamber C of the both sides which each chamber C adjoins too hastily in the shape of a chain mutually on the same conditions, respectively The coating conditions of the DLC film in each chamber C can be set up so that it may become the same more completely, and the DLC film of the plastic envelope in which coating is carried out by this in each chamber C becomes homogeneity more mutually.
[0086] Drawing 8 is the piping diagram showing roughly the configuration of the vacuum devices connected to each equipment of the above 1st thru/or 7.
[0087] In this drawing 8 , a reserve tank RT is connected to the inlet pipe L connected to Chamber C through a bulb V1, a vacuum pump PB is connected through a bulb V2, and Cryopump CP is further connected through the bulb V3, respectively. And vacuum pump PA is connected to the reserve tank RT.
[0088] Vacuum-pump PA consists of a mechanical booster pump MBA and a rotary pump RPA, and the vacuum pump PB consists of a mechanical booster pump MBB and a rotary pump RPB similarly. These mechanical booster pumps MBA and MBB are pumps with which rotary pumps RPA and RPB are assisted, respectively.
[0089] The material gas feeder RM and a massflow controller MC are connected to each chamber C through a bulb V4, and RF generator Rf and the matching box M are further connected to it. In addition, a bulb V5 is a leak valve which is connected to an inlet pipe L and leaks the inside of Chamber C among drawing 8 .
[0090] In addition, when connecting the vacuum devices of this drawing 8 to drawing 4 thru/or the equipment of 7, the vacuum duct D of drawing 4 thru/or the equipment of 7 corresponds to the inlet pipe L of the vacuum devices of drawing 8 .
[0091] Drawing 9 is the actuation Fig. showing the pressure variation in the chamber C corresponding to the actuation cycle of the above-mentioned vacuum devices, and actuation of these vacuum devices.
[0092] Hereafter, actuation of the vacuum devices of drawing 8 is explained based on drawing 9 .
[0093] In addition, closing motion control of each bulb and actuation control of a pump are performed to below by control units, such as a sequencer and a microcomputer.
[0094] A reserve tank RT is exhausted by actuation of vacuum pump PA before the exhaust air initiation in the chamber C by vacuum devices, and the internal degree of vacuum is maintained by the predetermined value.
[0095] And if plastic envelope B is held in each chamber C and this chamber C is sealed as mentioned above, a bulb V1 will be opened, the air in Chamber C will be attracted in a reserve tank RT, and the pressure in Chamber C will decline at a stretch (graph a).
[0096] If the pressure in each chamber C declines to a necessary pressure by suction by this reserve tank RT, after a bulb V1 is closed, a bulb V2 will be opened and the pressure in Chamber C will decline further with exhaust air by actuation of a vacuum pump PB (graph b).
[0097] In addition, after a bulb V1 is closed, the air in a tank is discharged by actuation of vacuum-pump PA, and, as for a reserve tank RT, an internal degree of vacuum returns to a predetermined value by it for the next coating. if the pressure in a reserve tank RT carries out a until fall to some extent with a rotary pump RPA at this time, the mechanical booster pump MBA will begin to function and the pressure in a reserve tank RT will decline at a stretch to a necessary value.
[0098] On the other hand, about a vacuum pump PB, the mechanical booster pump MBB begins to function with a rotary pump RPB, and the pressure in Chamber C is reduced at a stretch to a necessary value at the same time it opens a bulb V2, since the pressure in Chamber C is declining to the low-vacuum field by the reserve tank RT.
[0099] If the pressure in each chamber C declines to a necessary pressure with exhaust air by this vacuum pump PB, after a bulb V2 is closed, a bulb V3 will be opened by the degree and the pressure in Chamber C will decline further by coagulation adsorption of the gas by actuation of Cryopump PC (graph c).
[0100] This cryopump PC obtains a high degree of vacuum by carrying out coagulation adsorption of the gas molecule which remains in Chamber C by the gaseous helium refrigerator system.

[0101] If the pressure in each chamber C declines to a necessary pressure with this cryopump PC, a bulb V3 will be closed.
[0102] And while a bulb V2 is opened again after this, the material gas of the carbon source supplied through a massflow controller MC from the material gas feeder RM is introduced in Chamber C by opening a bulb V4 by suction by the vacuum pump PB.
[0103] After the pressure in Chamber C rises a little by installation of the material gas into Chamber C at this time (graph d), it is maintained by the fixed pressure by actuation of a vacuum pump PB (graph e).
[0104] Thus, while the material gas of requirements is introduced in each chamber C, coating of DLC to plastic envelope B is performed by supplying power to the external electrode 10 of Chamber C through a matching box M from RF generator Rf, and generating the plasma.
[0105] After the injection of the power from this RF generator Rf is performed fixed time, the leak valve V5 is opened wide and the inside of Chamber C is leaked (graph f).
[0106] Then, mass production of a DLC film coating plastic envelope is performed by being exchanged in plastic envelope B in Chamber C, and repeating a series of above-mentioned processes.
[0107] And after the pressure in a chamber declined at a stretch to the equilibrium pressure force by the reserve tank beforehand maintained by the high vacuum according to the above-mentioned vacuum devices, By carrying out sequential actuation of two or more vacuum pumps with which properties differ, and demonstrating each capacity in the pressure field suitable for the property of each vacuum pump to the maximum extent A high degree of vacuum can be obtained by short time amount, and the manufacture effectiveness of a DLC film coating plastic envelope can be gathered by this. Moreover, the load to each pump decreases and continuous running becomes possible.
[0108] Drawing 10 carries out two or more set (example of illustration four sets) connection of the manufacturing installation shown in drawing 4 , and shows the mode of the vacuum devices in the case of performing coating to coincidence to a lot of plastic envelopes.
[0109] In order that the vacuum devices in this example may gather the manufacture effectiveness of a DLC film coating plastic envelope, two or more set (this example four sets) arrangement of the manufacturing installation of drawing 4 is carried out, and each vacuum devices of each other are connected.
[0110] In drawing 10 , the reserve tank (henceforth the 1st reserve tank RT 1) of the manufacturing installation of drawing 4 is arranged on all sides, the 2nd reserve tank RT 2 is arranged further at that core, and the exhaust air in the chamber (not shown) arranged in the perimeter of the 1st reserve tank RT 1 by these two reserve tanks RT1 and RT2 in the shape of a circle is performed at high speed.
[0111] That is, as shown in drawing 11 , Cryopump CP is further connected [the 1st reserve tank RT 1] to the chamber C arranged in the perimeter of each 1st reserve tank RT 1 in the shape of a circle for the vacuum pump PB through the bulb V3 through the bulb V2 through the bulb V1 like the vacuum devices of drawing 8 , respectively.
[0112] And the 2nd reserve tank RT 2 is connected to Chamber C through bulb V1'.
[0113] In addition, in drawing 11 , VM is the vacuum gage connected to Chamber C through the bulb V6, and the same sign is attached about the same configuration as other drawing 8 .
[0114] One set of vacuum pump PA is connected through the exhaust pipe L1 about the tank of two ******, respectively, the exhaust air in the 1st reserve tank RT 1 is performed by this vacuum pump PA, and vacuum pump PA' is connected to the 1st reserve tank RT 1, and the exhaust air in the 2nd reserve tank RT 2 is performed to the 2nd reserve tank RT 2 by this vacuum pump PA' at it so that drawing 10 may show.
[0115] These vacuum devices operate in order of the 1st reserve tank RT 1, the 2nd reserve tank RT 2, vacuum-pump PB, and Cryopump PC, and they exhaust until the inside of the inside C of this chamber becomes a predetermined degree of vacuum from the chamber C arranged in the perimeter of each 1st reserve tank RT 1 in the shape of a circle.
[0116] That is, the 1st reserve tank RT 1 and the 2nd reserve tank RT 2 are exhausted by actuation of vacuum pump PA and PA' before the exhaust air initiation in Chamber C, respectively, and the internal degree of vacuum is maintained by the predetermined value.
[0117] And if plastic envelope B is held in each chamber C and this chamber C is sealed, a bulb V1 is opened and the air in Chamber C is attracted in the 1st reserve tank RT 1, and it will fall at a stretch until the pressure in this chamber C balances the pressure in the 1st reserve tank RT 1.
[0118] After a bulb V1 is closed next, bulb V1' is opened and suction by the 2nd reserve tank RT 2 is performed, and it falls further until the pressure in each chamber C balances the pressure in the 2nd reserve tank RT 2.
[0119] Furthermore, after bulb V1' is closed, a bulb V2 is opened, the inside of Chamber C is further exhausted by actuation of a vacuum pump PB, and the pressure of the interior declines further.
[0120] In addition, after a bulb V1 is closed, the air in a tank is discharged by actuation of vacuum-pump PA,

and, as for the 1st reserve tank RT 1, an internal degree of vacuum returns to a predetermined value by it for the next coating. Moreover, after bul[illegible]' is closed, the air in a tank is discha[illegible] by actuation of vacuum-pump PA', and, as for the 2nd reserve tank RT 2, an internal degree of vacuum returns to a predetermined value by it for the next coating.

[0121] If the pressure in each chamber C declines to a necessary pressure by actuation of a vacuum pump PB, after a bulb V2 is closed, a bulb V3 will be opened by the degree and the pressure in Chamber C will decline further by coagulation adsorption of the gas by actuation of Cryopump PC.

[0122] If it falls with this cryopump PC to the necessary pressure which needs the pressure in each chamber C for plasma discharge, a bulb V3 is closed, and while a bulb V2 is opened again after this, the material gas of the carbon source supplied through a massflow controller MC from the material gas feeder RM will be introduced in Chamber C by opening a bulb V4 by suction by the vacuum pump PB.

[0123] With this, plasma discharge is performed in each chamber C, and coating of DLC to the plastic envelope in Chamber C is performed. And after this plasma discharge is performed predetermined time, the leak valve V5 is opened wide and the inside of Chamber C is leaked.

[0124] And mass production of a DLC film coating plastic envelope is performed by being exchanged in the plastic envelope in Chamber C, and repeating a series of above-mentioned processes.

[0125] Since this drawing 10 and the vacuum devices of 11 are equipped with the 2nd mass reserve tank RT 2 besides the 1st reserve tank RT 1 prepared for each [of Chamber C] circle of every and perform gradually the inhalation of air in the chamber C by the reserve tank, they can reduce the pressure in Chamber C at a stretch, and can reduce purge timing sharply.

[Translation done.]

* NOTICES *

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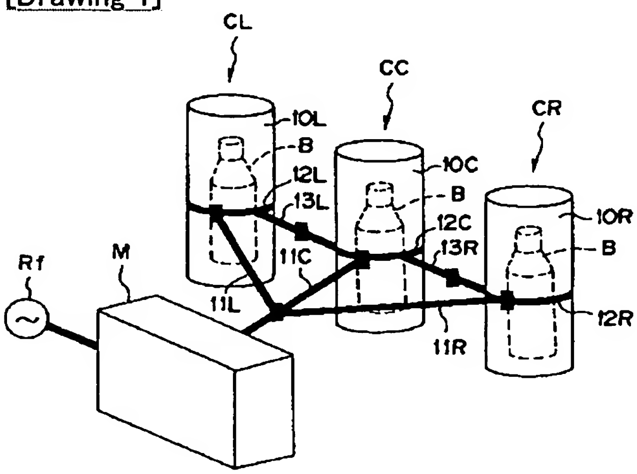
damages caused by the use of this translation.

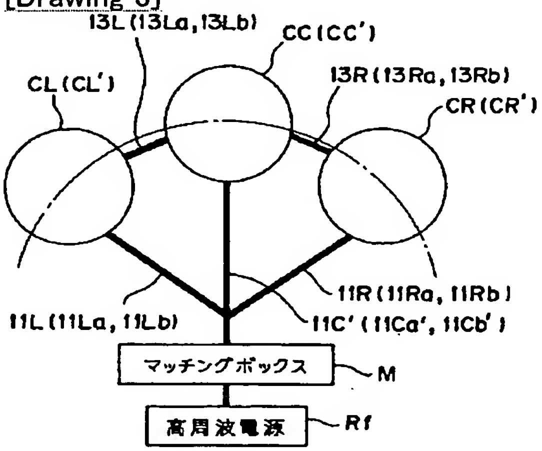
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

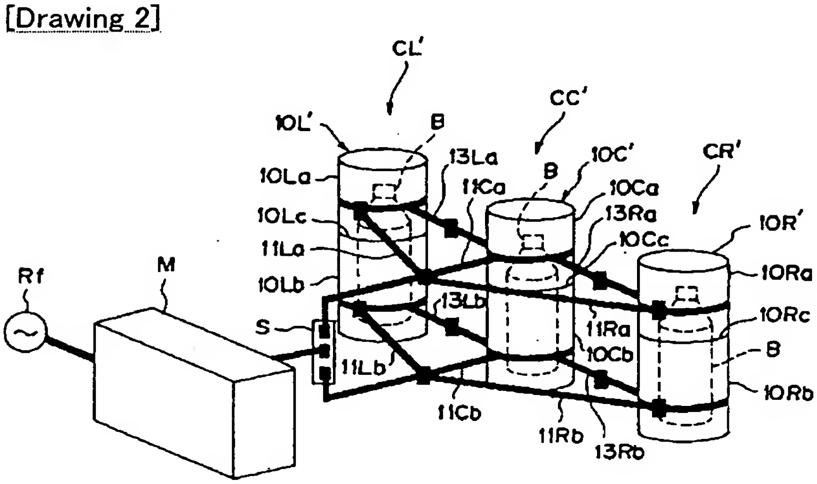
[Drawing 1]



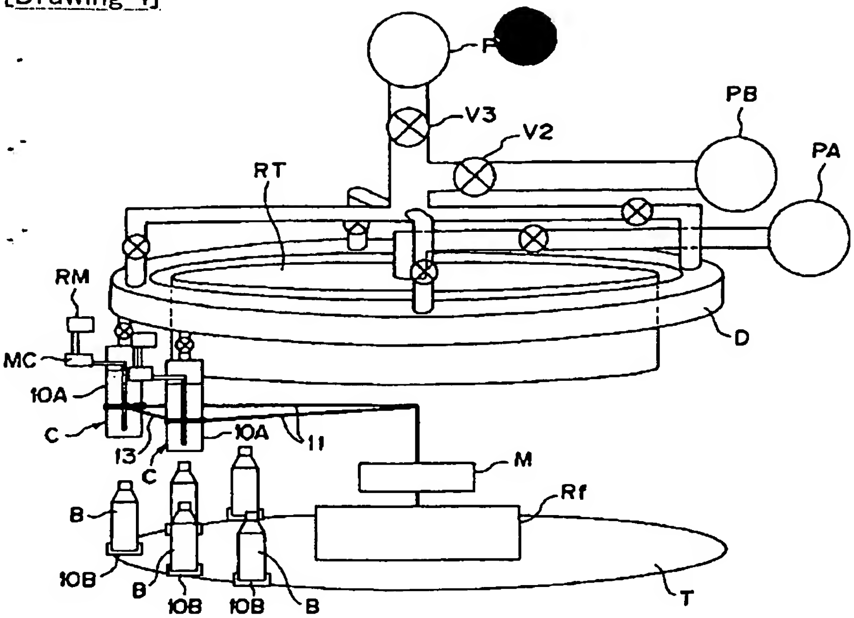
[Drawing 3]



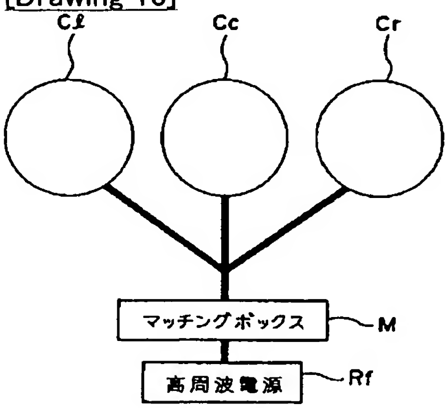
[Drawing 2]



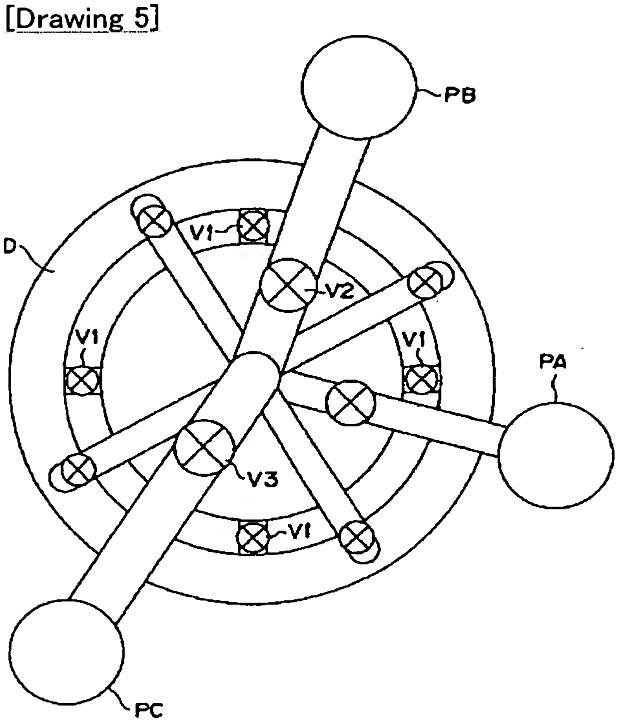
[Drawing 4]



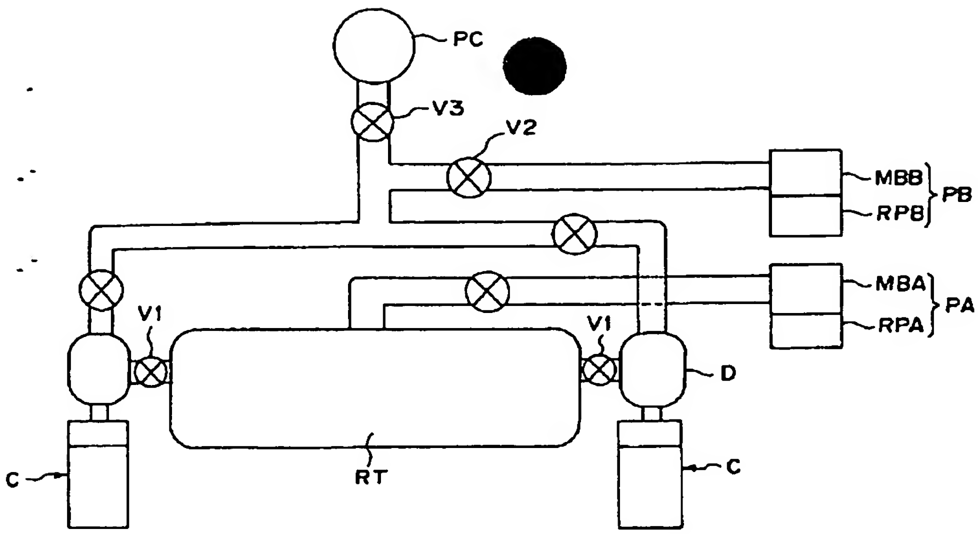
[Drawing 13]



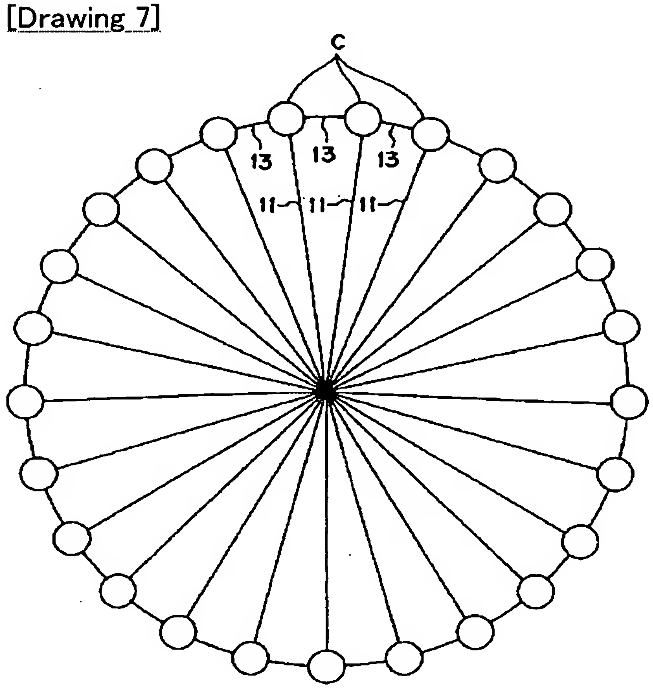
[Drawing 5]



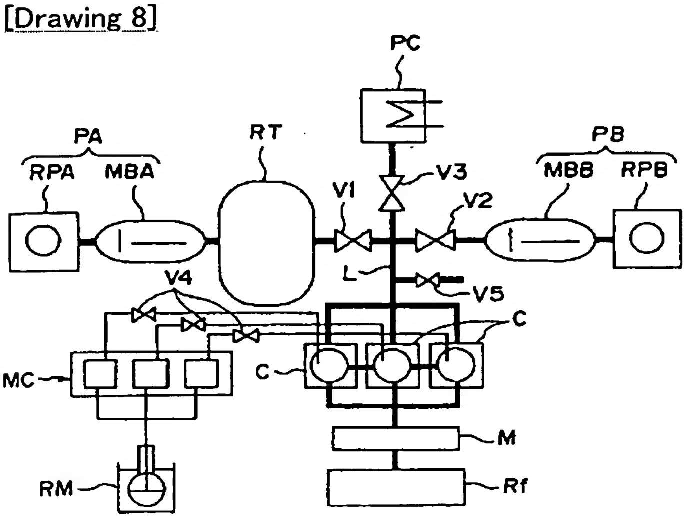
[Drawing 6]



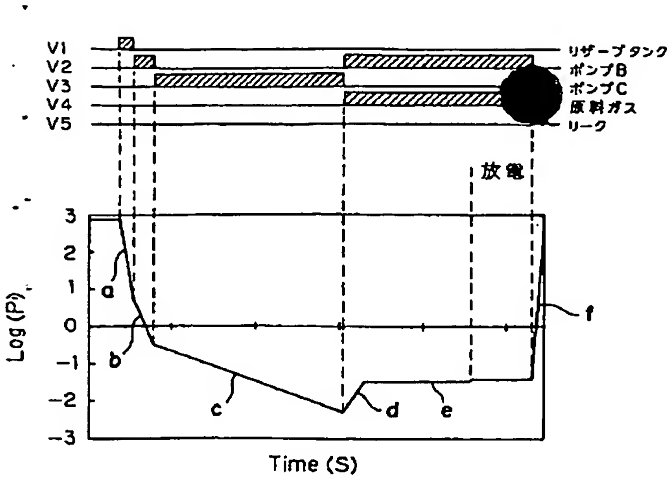
[Drawing 7]



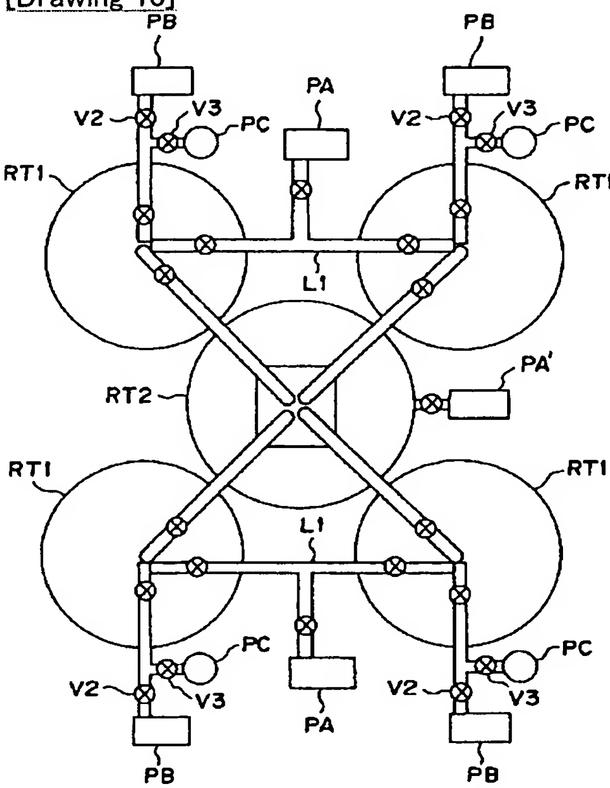
[Drawing 8]



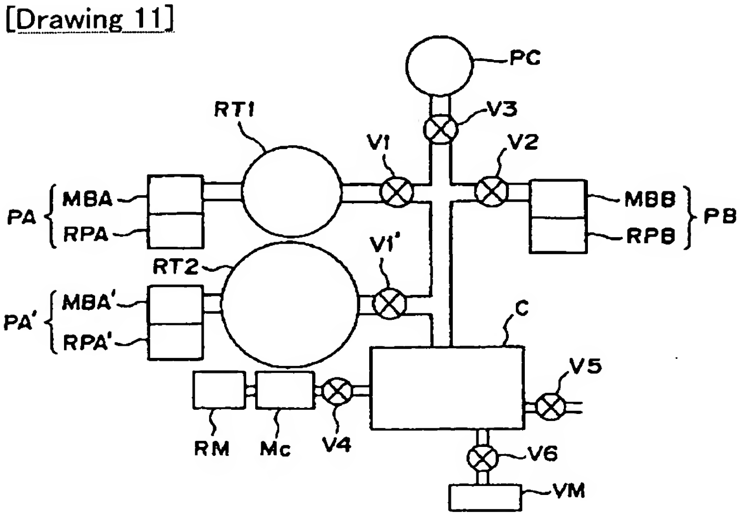
[Drawing 9]



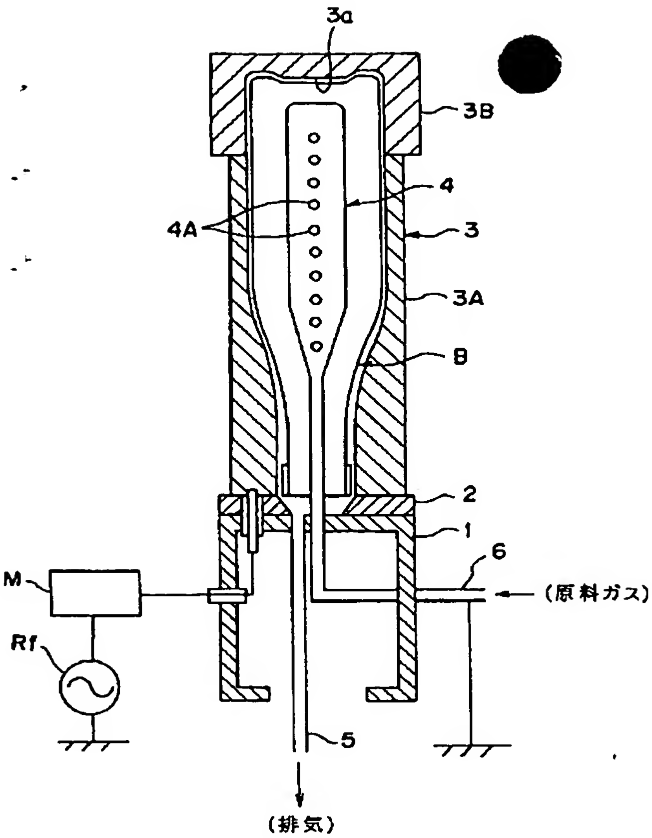
[Drawing 10]



[Drawing 11]



[Drawing 12]



[Translation done.]